TEXTILE INDUSTRY TO CONTROL MICROBIAL GROWTH

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INTRODUCTION

Textiles, due to their large specific surface area and capacity to retain moisture, provide an excellent environment for microbial growth. Some skin disorders get exacerbated by the use of inappropriate clothing, which may cause discomfort during the disease outbreak. Antimicrobial finishing of textiles is a way to prevent such outbreaks and to relief some symptoms associated with the disease. Thus, the use of antibacterial agents is becoming a standard finish for textile goods. An alternative that combines a non-toxic and biodegradable agent with antimicrobial, and also anti-inflammatory activities, such as chitosan , is an interesting choice. Chitosan derivatives have been prepared by several methods in order to increase the antimicrobial activity by means of grafting with *N*-alkyl groups, quaternary ammonium groups, esters, among others (Kenawy et al., 2007). In this sense, the chemical fixation of the chitosan by covalent cross-linking into the cellulose or wool matrices may improve the endurance and efficiency of the resultant functionalised textile (Lim and Hudson, 2004; Zhang et al., 2003). Besides chitosan attachment to the fabric, laudering durability is one of the requisites for a successful finishing (Rao and Cranston, 2008). Therefore, in this study we tested the anti-microbial efficacy of chitosan when added to cotton fabric by aid of cross-linkers, as well as its laudering durability.

METHODOLOGY

Fabric preparation

Cotton fabric was completely immersed in a solution containing 1% chitosan (ca. 600 kDa), and the cross-linking agent tested (2.5%). Impregnation was achieved by the pad-dry-cure method (Figure 1). The pick up was determined by weighing the fabric before and after impregnation and found to be 79%. The fabric was allowed to dry at 100 ºC for 4 min., after which it was thermofixed at 140 ºC for 4 min. It is at this stage that the cross-linking agent will reticulate and "link" the chitosan to the fabric. The fabric was cut into 4.8 cm dia. rounds and sterilized by exposure to UV for 15 min.

The chitosan solutions were previously prepared in 1 %(v/v) acetic acid, and allowed to dissolve for 24 h at 50º C; the pH was then adjusted to 5.6-5.8 with NaOH (10 M).

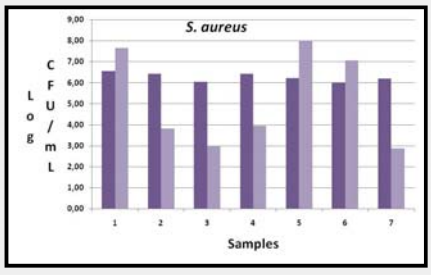
The cross-linking agentes tested in this study were: BayPret USV, Primal Eco 934, Glyoxal, Fixapret and Gluteraldehyde.

Antimicrobial activity

The assessment of the antimicrobial activity was carried out according to the standard procedure described in the AATCC test method 100-2004. The fabric rounds were inoculated with 1 mL of a bacterial suspension (*Staphylococcus aureus* and *Escherichia coli*) containing ca. 10^5 CFU/mL, and then incubated at 37º C. Standard plate counts were performed by 1, 6 and 24 h of incubation, and the percent reduction (*R*) was determined as $R = 100\,(B\text{-}A)/B$ — where *A* represents the number of bacteria recovered from the inoculated treated rounds incubated over the desired contact period, and *B* represents the number of bacteria recovered from the inoculated treated rounds immediately after inoculation.

Figure 1. Foulard where the fabric impregnation took place.

RESULTS



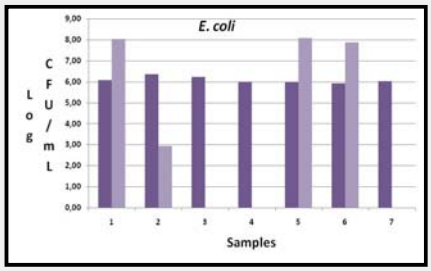


Figure 2. Decrease in viable numbers of bacteria at 0 (-■-) and after 6 h of contact (-■-) in control samples (1), with chitosan and glyoxal added by conventional exhaust (2), with chitosan and glyoxal added by pad-dry-cure method (3), with chitosan and glyoxal added by the pad-dry-cure method (5 min) (4), with chitosan and fixapret added by the pad-dry-cure method (5), with chitosan , fixapret and condensol added by the pad-dry-cure method (6) and with chitosan and gluteraldehyde added by the pad-dry-cure method (7).

The use of BayPret USV and Primal Eco 934 cross-linkers did not inhibit microbial growth, suggesting that chitosan was not effectively linked to the fabric (data not shown).

Glyoxal and Gluteraldehyde added by the pad-dry-cure method produced a significant reduction. Although this effect was different in the two bacteria tested (*E. coli* was strongly inhibited when compared to *S. aureus*, see Figure 2), both cross-linkers showed a similar effect.

These samples also showed good laundering durability at 1 and 5 washing cycles.

CONCLUSIONS

✓The efficacy of cross-linkers should be considered individually and according to the conditions used in the fabric impregnation.

✓Differential microbial inhibition may work as an advantage in functionalised textiles since total elimination of the skin resident flora is viewed as a concern.

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